

WHAT IS CLAIMED IS:

1. An ink-jet apparatus employing an ink-jet head capable of ejecting an ink in variable of an ejection amount in a plurality of steps and performing printing by ejecting an ink from the ink-jet head toward a printing medium, comprising:

printing means for performing printing operation in a predetermined ink ejection amount among the 10 plurality of steps of ink ejection amounts in said ink-jet head; and

preliminary ejection means for performing ink ejection not associated with printing, from said ink-jet head, at an ejection amount greater than said 15 predetermined ink ejection amount among the plurality of steps of ink ejection amounts.

2. An ink-jet apparatus employing an ink-jet head having a plurality of energy generating elements corresponding to one ejection opening and performing 20 printing by ejecting an ink to a printing medium utilizing the energy generated by the energy generating elements, comprising:

printing means for performing printing operation 25 in a plurality of ink ejection amount modes established by combination of an energy generating

element to be used among the plurality of energy generating elements; and

preliminary ejection means for performing ink ejection not associated with printing, from said ink-jet head used for printing operation, while said printing operation is performed in one of said plurality of ejection amount modes, the ink ejection by said preliminary means being performed in the ejection amount mode having ejection amount greater than or equal to the ejection amount of the ejection amount mode employed in said printing operation.

3. An ink-jet apparatus as claimed in claim 2, wherein the plurality of energy generating elements are mutually differentiated the magnitude of the energy to be generated.

4. An ink-jet apparatus as claimed in claim 2, wherein the plurality of energy generating elements generates equal magnitude of energy to each other and said printing means differentiates the ejection amount modes by varying number of energy generating elements to be used.

5. An ink-jet apparatus as claimed in claim 4, wherein, in printing operation of the ejection amount

mode, in which not all of the plurality of energy generating elements are used, said preliminary ejection means performs ink ejection with employing one greater number of energy generating elements than 5 that employed in said printing operation.

6. An ink-jet apparatus employing an ink-jet head having a plurality of energy generating elements corresponding to one ejection opening and performing 10 printing by ejecting an ink to a printing medium utilizing the energy generated by the energy generating elements, comprising:

printing means for performing printing operation in a plurality of ink ejection amount modes 15 established by combination of an energy generating element to be used among the plurality of energy generating elements; and

preliminary ejection executing means having preliminary ejection modes respectively corresponding 20 to the plurality of ejection amount modes.

7. An ink-jet apparatus as claimed in claim 6, wherein said preliminary ejection executing means further has a preliminary ejection mode upon switching 25 of the ejection amount modes.

8. An ink-jet apparatus as claimed in claim 2,
wherein the energy generating element generates a
thermal energy to generate bubble in the ink for
ejecting the ink by generation of the bubble.

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9. An ink-jet apparatus employing an ink-jet head
having a plurality of heaters corresponding to one
ejection opening and performing printing by ejecting
an ink from said ink-jet head to a printing medium,

10 comprising:

driving means for applying respective pulses to
the plurality of heaters for bubbling the ink for
ejecting the ink through said one ejection opening,
said driving means being capable of mutually shifting
15 timings of bubbling at respective of said plurality of
heaters on a basis of information relating to an ink
temperature of said ink-jet head.

10. An ink-jet apparatus as claimed in claim 9,
20 wherein the plurality of heaters are heaters identical
in position relative to one ejection opening, size and
heating characteristics with respect to each other.

11. An ink-jet apparatus as claimed in claim 9,
25 wherein the plurality of heaters are heaters different

in position relative to one ejection opening, size and heating characteristics with respect to each other.

12. An ejection amount controlling method in an ink-

5 jet apparatus employing an ink ejecting portion having a plurality of heaters corresponding to one ejection opening and ejecting ink from said ink ejecting portion to a printing medium, said method comprising the step of:

10 adjusting an ink ejection amount by mutually shifting bubbling timing at respective of the plurality of heaters upon application of respective pulses to the plurality of heaters for causing bubbling of ink to eject ink through the ink ejection
15 opening.

13. An ejection amount stabilizing method in an ink-

jet apparatus employing an ink ejecting portion having a plurality of heaters corresponding to one ejection opening and ejecting ink from said ink ejecting portion to a printing medium, said method comprising the step of:

stabilizing an ink ejection amount by mutually shifting bubbling timing at respective of the plurality of heaters upon application of respective pulses to the plurality of heaters for causing

bubbling of ink to eject ink through the ink ejection opening so as to adjust the ink ejection amount.

5 14. An ink-jet apparatus employing an ink-jet head having a plurality of heaters corresponding to one ejection opening, and ejecting ink from said ink-jet head to a printing medium, comprising:

10 head driving means for applying a preceding pulse which does not cause ejection and a subsequent pulse following said preceding pulse to generate a bubble for ejecting the ink;

15 ejection amount mode setting means for setting an ejection amount mode by selecting heater to be applied the subsequent pulse among said plurality of heaters; and

20 pre-pulse control means for controlling application of the preceding pulse through said head driving means in respective ejection amount modes set by said ejection amount mode setting means, on a basis of information relating to an ink temperature of said ink-jet head.

25 15. An ink-jet apparatus employing an ink-jet head arranged first and second heaters corresponding to one ejection openings and ejecting an ink droplet of a

selected one of a plurality of ejection amounts by generating bubble by driving said first and second heaters in combination, comprising:

driving means for driving said first and second
5 heaters with a pre-heat pulse in advance of driving
with a main heating pulse.

16. An ink-jet apparatus as claimed in claim 15,
wherein said driving means has an ejection amount mode
10 established by driving said first heater, an ejection
amount mode established by driving said second heater,
and an ejection amount mode established by driving
both of said first and second heaters.

15 17. An ink-jet apparatus as claimed in claim 16,
wherein said driving means performs control of the
pre-heat pulse at least on a basis of a temperature
information of the ink-jet head and/or temperature
calculated value of the ink-jet head.

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18. An ink-jet apparatus as claimed in claim 16,
wherein said driving means varies setting of the
heaters driven by the pre-heat pulse and/or pre-heat
control mode depending upon the ejection amount mode.

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19. An ink-jet apparatus as claimed in claim 18,
wherein said driving means performs at least pre-
heating by the heater driving for main heating.
- 5 20. An ink-jet apparatus as claimed in claim 18,
wherein said driving mans performs pre-heating with
the heater other than the heater driven for main
heating.
- 10 21. An ink-jet apparatus as claimed in claim 17,
wherein the control of the pre-heat pulse by said
driving means is to vary a pulse width of the pre-
heat-pulse.
- 15 22. An ink-jet apparatus as claimed in claim 17,
wherein the control of the pre-heat pulse by said
driving means is to vary a period between said the
pre-heat pulse and the main heat pulse.
- 20 23. An ink-jet apparatus as claimed in claim 17,
wherein said driving means varies a control mode of
pre-heating depending upon the ejection amount mode.
24. An ink-jet apparatus as claimed in claim 23,
25 wherein said driving means switches the heater to be

driven by the pre-heat pulse depending upon the head temperature information of the ink jet head.

25. An ink-jet apparatus as claimed in claim 17,
5 wherein said driving means drives different heaters with the pre-heat pulse and the main heat pulse, respectively.

26. An ink-jet apparatus employing an ink-jet head
10 arranged a plurality of mutually different heaters corresponding to one ejection opening and ejecting ink droplet of a plurality of mutually different ejection amounts by driving the plurality of heaters in combination to generate a bubble, comprising:
15 a table used for driving the heaters in the combination corresponding to respective combinations of said plurality of heaters.

27. An ink-jet apparatus as claimed in claim 26,
20 wherein said table includes a table used for driving two or more of said plurality of heaters.

28. An ink-jet apparatus as claimed in claim 27
wherein said table is switched depending upon the
25 temperature information of said ink-jet head.

29. An ink-jet apparatus employing an ink-jet head arranged a plurality of heaters corresponding to one ejection opening and ejecting an ink from the ink-jet head to a printing medium, comprising:

5 setting means for setting presence or absence in heater driving irrespective of ejection data for respective of the plurality of heaters; and

ejection data setting means for establishing correspondence between ejection data and the ejection 10 openings to perform ink ejection on a basis of said ejection data, depending upon combination of presence or absence of driven heaters set by said setting means.

15 30. An ink-jet apparatus as claimed in claim 29, wherein a density of printing is set by setting by said setting means and correspondence established by said ejection data setting means.

20 31. An ink-jet apparatus as claimed in claim 29, wherein ejecting position between a plurality of ink-jet heads is adjusted by setting by said setting means and correspondence established by said ejection data setting means.

32. An ink-jet apparatus as claimed in claim 29
wherein an ink amount to be ejected for one pixel is
set by setting by said setting means and
correspondence established by said ejection data
5 setting means.

33. An ink-jet apparatus as claimed in claim 29, which
further comprises data generating means for generating
interpolating ejection data on a basis of the ejection
10 data and wherein said ejection data setting means
establishes correspondence of the interpolating
ejection data to the ejection openings other than the
ejection openings for which correspondence has been
established.

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34. An ink-jet apparatus as claimed in claim 32,
wherein the ink amount to be ejected for one pixel is
determined by setting of the ejection amount of
respective of ejection openings for which the
20 correspondence have been established by the
combination of said driven heaters.

35. An ink-jet apparatus as claimed in claim 33, which
further comprises a feeding amount setting means for
25 setting relative shifting magnitude between said ink-
jet head and said printing medium depending upon

combination of presence and absence of driven heater set by said setting means, and wherein printing is performed for a given range on the printing medium by scanning of said ink-jet head for the times determined
5 by said relative shifting magnitude set by said feeding amount setting means.

36. An ink-jet apparatus as claimed in claim 34, wherein said ejection timing is varied depending upon
10 the ejection amount set with respect to the corresponded ejection opening.

37. An ink-jet apparatus for performing printing employing an ink-jet head having ejection openings
15 which can sequentially differentiate a size of ink droplet among a plurality of sizes per in each scanning cycle or per every scanning cycles, comprising:

means for driving said ink-jet head with
20 relatively shifting said ink-jet head relative to said printing medium so that a plurality of different sizes of ink droplets are ejected so as to form a plurality of different sizes of dots which are complementary disposed to each other.

38. An ink-jet apparatus as claimed in claim 37,
wherein said plurality of sizes of ink droplets are
formed by combination of a plurality of heaters in
said ink-jet head.

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39. An ink-jet apparatus as claimed in claim 37,
wherein combination of said plurality of heaters is
differentiated depending upon a kind of the printing
medium to be used.

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40. An ink-jet apparatus for performing printing
employing an ink-jet head having ejection openings
which can sequentially differentiate a size of ink
droplet among a plurality of sizes per in each
15 scanning cycle or per every scanning cycles, wherein
ejection timing of is differentiated depending
upon the size of the ink droplet.

41. An ink-jet apparatus having an ink-jet head
20 capable of ejecting mutually different two sized of
ink droplets and capable of reciprocal printing,
comprising:

first mode executing means for performing printing
with a large ink droplet in one of forward and reverse
25 printing directions;

second mode executing means for performing printing with a small ink droplet in the other of the forward and reverse printing directions; and switching means for switching said first and 5 second modes.

42. An ink-jet apparatus having an ink-jet head capable of ejecting mutually different two sizes of ink droplets, comprising:

10 means for varying ejection timing of the ink droplet depending upon the size of the ink droplet or combination of heaters to be driven.

43. An ink-jet apparatus employing an ink-jet head, in 15 which a plurality of ejection openings are arranged in a form of array, and performing printing of a density of $1/N$ with ejection opening group of $1/N$ ($N \geq 2$) of ejection opening array, comprising:

printing executing means for executing ejection 20 mode depending upon the density.

44. An ink-jet apparatus employing ink ejecting portion having a plurality of heaters corresponding to one ejection opening and ejecting ink from the ink 25 ejecting portion to a printing medium, comprising:

driving means for driving the plurality of heaters with varying combination of the heaters to be driven and/or varying driving energy to be applied to the heaters to be driven.

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45. An ink-jet apparatus employing an ink-jet head capable of ejecting an ink in variable of an ejection amount in a plurality of steps and performing printing by ejecting an ink from the ink-jet head toward a

10 printing medium, comprising:

preliminary ejection means for performing preliminary ejection operation with a large ejection amount and preliminary ejection operation with a small ejection amount; and

15 preliminary ejection interval setting means for setting an interval between preliminary ejection operations with the small ejection amount shorter than an interval between preliminary ejection operations with the large ejection amount.

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46. A method for performing a preliminary ejection not associated with printing from an ink-jet head capable of ejecting an ink in variable of an ejection amount in a plurality of steps, comprising the steps of:

25 performing preliminary ejection operation with a large ejection amount;

performing preliminary ejection operation with a small ejection amount; and

setting an interval between preliminary ejection operations with the small ejection amount shorter than
5 an interval between preliminary ejection operations with the large ejection amount.